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DOI: https://doi.org/10.1159/000354553

Digestive Surgery

Dig Surg 2014;31:25–32
DOI: 10.1159/000354553

Published online: May 8, 2014

Where to Begin and Where to End? Preoperative Assessment for Patients Undergoing Metabolic Surgery

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Key Words

Metabolic surgery · Preoperative assessment · Evidence-based medicine · Extent of testing · Guidelines

Abstract

Bariatric surgery is the most effective treatment of obesity and its associated diseases like type 2 diabetes mellitus. Given the obesity epidemic and the efficacy of surgical treatment, the number of surgical weight loss procedures has grown in recent years. Nevertheless, there is little consensus regarding the extent of preoperative investigations required prior to patients undergoing surgery. This article aims to discuss the available evidence on which preoperative tests are useful for the detection and treatment of conditions such as venous thromboembolism, obstructive sleep apnea syndrome and *Helicobacter pylori*-positive gastritis prior to an operation. The present literature suggests that only a few preoperative investigations are essential, but that preoperative multidisciplinary care is beneficial.

Introduction

Obesity and its associated diseases have increased dramatically over the last decade [1]. Surgical procedures such as Roux-en-Y gastric bypass (RYGB) do not merely reduce body weight but also ameliorate concomitant metabolic burden. Therefore, the term 'metabolic surgery' has gradually replaced 'bariatric surgery'. Metabolic surgery will soon be part of routine management algorithms for type 2 diabetes mellitus (T2DM) alongside and in conjunction with lifestyle interventions and pharmacotherapy [2].

The numbers of metabolic surgery procedures worldwide have risen steeply over the last years [3]. Despite the fact that perioperative risks are increased and physiological and anatomical conditions are altered in morbidly obese patients, there are few specific guidelines for the preoperative assessment of patients undergoing metabolic surgery. Those that do exist are either not up to date or lack practical applicability further limiting their clinical use. Even though the perceived risk profile of obese pa-

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tients encourages clinicians to undertake thorough preoperative assessments, some of the diagnostic tools used should be questioned because they lack evidence that their use makes any difference. This review aims to provide a critical overview of preoperative assessment in obese patients planned for metabolic surgery.

Multidisciplinary Care

Depending on the type of surgical procedure chosen, there is a variety of effects such as reduced hunger, increased and prolonged satiation [4, 5], altered meal size frequency [6] and food preferences [7, 8], micronutrient deficiencies [9], which all come along with manifold behavioral changes and adaptations from the patients. Furthermore, functional problems including nausea, vomiting, dehydration and benign abdominal pain account for about 50% of readmissions to the emergency department of the hospital within the first 3 months after metabolic surgery [10]. Thus, most authors agree that a multidisciplinary team approach during the pre-, peri- and postoperative periods optimizes metabolic surgery patient care [11]. Such a multidisciplinary team should include at least a bariatric surgeon, an internist with a focus on obesity medicine, a psychiatrist or psychologist as well as a nutritionist and a clinical nurse specialist. Ideally, patients should be introduced to the entire team before surgery.

Although this interdisciplinary approach is generally accepted and regarded as common sense, there is in fact little scientific evidence that a multidisciplinary workup in the preoperative setting results in better outcome and reduced number of pre- and postoperative complications [12].

Nutritional Assessment

Many morbidly obese patients have micronutrient deficiencies [13], which can be exacerbated by the reductions in food intake and rearrangements of the gastrointestinal tract following metabolic surgery. Deficiencies in vitamins B_{12}, B_1, C, folate, A, D, and K and in iron, selenium, zinc and copper are thought to be especially likely. Thus, regular monitoring of serum micronutrient levels should start preoperatively [9]. Depending on the procedure, most patients are prescribed daily multivitamin and trace mineral supplements after their surgery. General preoperative screening and unfocussed substitution of micronutrients again seems to be based more on common sense than evidence.

Cardiovascular Assessment

Hypertension, hypercholesterolemia and T2DM are all classical risk factors for cardiovascular disease (CVD) and are significantly increased in obese individuals [14]. Increased blood volume in these patients additionally may lead to left ventricular hypertrophy. Furthermore, obesity itself has been shown to be an independent risk factor for CVD particularly among women [15]. Morbidly obese patients may thus be predisposed for cardiac events.

Guidelines such as those of the American College of Cardiology and American Heart Association [16] now use the revised cardiac risk index which includes history of ischemic heart disease, history of heart failure, and history of cerebrovascular disease, T2DM and renal insufficiency. The guidelines suggest that unstable coronary syndrome, decompensated heart failure, significant arrhythmias and severe valvular disease are contraindications for metabolic surgery because intraperitoneal surgery is classified as intermediate risk for coronary events. Even if metabolic surgery is elective, the increased risk for myocardial infarction in the above-defined patient group may be 1–5% with potentially fatal outcome and thus, metabolic surgery may not be justified in this group without better quality evidence.

The increased cardiovascular risk has to be balanced with the expected benefits of metabolic surgery. For example, a reduction of cardiovascular morbidity by approximately 25–50% has been demonstrated after metabolic surgery when compared with BMI- and age-matched controls or those with nonsurgical weight loss [17, 18].

A resting 12-lead electrocardiogram is performed routinely in most institutions, although there is no evidence of benefit as a screening tool for significant arrhythmias in patients without symptoms or clinical abnormalities in morbidly obese patients. In patients with at least 2 risk factors of ischemic heart disease and poor functional capacity, a noninvasive stress test by either a radionuclide myocardial perfusion imaging or a dobutamine stress echocardiography is recommended. Nevertheless, the considerable subcutaneous adipose tissue may make the interpretation of these tests very difficult and the risk of false-positives high. Functional capacity may be a better measurement. Adequate functional capacity can be defined as 4 metabolic equivalents, which correspond to the climbing of 2 flights of stairs [16].

Transthoracic dobutamine stress echocardiography may help stratify the cardiac dysfunction of morbidly obese patients and is safe. However, the low yield of positive tests together with a low positive predictive value for significant coronary artery disease questions its clinical

value [19]. Thus, more invasive diagnostic tools like transesophageal stress echocardiography might be of greater value in some cases.

The findings of echocardiography (e.g. eccentric cardiac hypertrophy) and invasive tests can lead to a change of medical treatment or cardiological interventions like percutaneous thromboangioplasty or stenting. Numerous studies have shown the benefit of starting medications, such as statins and β-blockers, in the preoperative setting to reduce cardiac risk [20]. However, β-blockers to reduce the incidence of postoperative myocardial ischemia, myocardial infarction, and cardiac mortality by decreasing myocardial oxygen consumption and workload have not been studied specifically in morbidly obese patients [19, 21].

If coronary stenting is needed, planned metabolic surgery has to be postponed for approximately 1 year [20].

Thromboembolic Risk Assessment

Flum et al. [22] showed in a prospective, observational study of 4,610 patients that venous thromboembolism is not only a complication of metabolic surgery but also a reliable predictor of adverse postoperative outcomes.

Obesity contributes to the thromboembolic risk of surgery, which ranges from 0.15 to 2% [22–24]. The low mortality of about 0.3% after metabolic surgery makes it difficult to identify the cause of death. However, in all observational studies investigating mortality related to metabolic surgery, pulmonary embolism (PE) is the most frequent cause [25].

Routine screening for phlebothrombosis by duplex sonography is not mandatory in the obese but recommended in patients with pulmonary hypertension or antecedent deep vein thrombosis [26].

Low-molecular-weight heparin (LMWH) in combination with sequential compression devices and early mobilization are effective in reducing the risk of thromboembolic events. Weight-based dose adjustments and extended prophylaxis may be beneficial [27].

Due to the increased risk for thromboembolic complications in obese patients, some authors recommend the application of LMWH twice a day for patients with BMI >50, age >50 years, male sex, venous insufficiency, hypoventilation syndrome, smoking or history of thrombosis [23]. However, there is not yet enough evidence to support such aggressive prophylaxis regimens.

Other authors recommend that prophylactic placement of a removable inferior vena cava filter should be considered for high-risk super-obese patients with BMI >55, a previous history of deep vein thrombosis, PE, or pulmonary hypertension (pulmonary artery pressure >40 mm Hg). Gargiulo et al. [28] demonstrated in such a selected patient group a reduction in PE with vena cava filter placement prior to open RYGB surgery. The reduced PE rates after laparoscopic surgery and the potentially severe complications of vena cava filters may explain why this has not become a standard procedure.

Pulmonary Assessment

Obesity impairs respiratory function by decreasing compliance of the lung and by increasing airway resistance. Preoperative pulmonary spirometry might be useful as a relatively simple screening tool because first, airflow obstruction and airflow reversibility probably increase complications [29], and second, patients with impaired lung function may not have overt respiratory symptoms [30].

Obstructive sleep apnea syndrome (OSAS) and obesity hypoventilation syndrome (OHS) may adversely affect surgical outcome [22]. OSAS is present in more than 70% of the population undergoing metabolic surgery and remains undetected in more than 80% prior to surgery [31]. OSAS and OHS can be diagnosed by polysomnography and arterial blood gas analysis. OSAS with significant hypoxia requires continuous positive airway pressure (CPAP) therapy prior to surgery.

The value of routine preoperative chest X-rays has long been disputed [32]. In the absence of known cardiac or pulmonary disease, a chest X-ray changes the management of patients only in 0.1%, suggesting that chest X-rays should be limited to patients with clinical findings [33].

Metabolic Assessment

Obesity is an important risk factor for T2DM, and approximately 15–25% of morbidly obese patients have T2DM. Poor control of hyperglycemia in the first 24 h after surgery is associated with increased rates of postoperative infectious complications [34].

Endocrine causes of obesity include hypothyroidism and Cushing's disease. Although preoperative testing for such endocrine diseases very rarely yields results, some centers routinely use thyroid function testing, dexamethasone suppression tests and other endocrine diagnostics. Many centers refer all their patients for endocrinological

evaluation prior to surgery, even though there is only level D evidence as to the benefit of such preoperative workup [12].

Gastrointestinal Assessment

The role of preoperative upper endoscopy (EGD) in obese patients prior to metabolic surgery is controversial. Those that propagate a preoperative endoscopic assessment of all patients point out its high diagnostic yield and the low cost. Sharaf et al. [35] reported that preoperative EGD revealed clinically important findings that affected the timing or choice of surgical treatment in 61.5% of their patients. In contrast, Schirmer et al. [36] reported that EGD changed the subsequent surgical treatment in only 5% of their cases.

The high prevalence of *Helicobacter pylori* (HP) alone does not justify preoperative EGD. First, because the prevalence of a pathological condition does not automatically implicate a treatment, and second, because a higher BMI is not associated with an increased risk for HP infection [37]. However, the significantly lower incidence of marginal ulcers at the gastrojejunal anastomosis in patients who underwent preoperative EGD prior to RYGB surgery ($p < 0.05$) supports HP infection testing routinely in the preoperative assessment [36]. Less invasive testing like 13C urea breath test can be considered as an alternative. Screening for HP infection makes sense only if positive findings are followed by antibiotic therapy whose efficacy needs to be controlled before surgery, either by repeating EGD or by performance of a 13C urea breath test.

Obesity has been associated in several studies with a 1- to 2-fold increase in the risk of gastroesophageal reflux disease (GERD) and its complications, such as erosive esophagitis and esophageal adenocarcinoma [38]. Patterson et al. [39] have suggested that laparoscopic RYGB is not inferior to a Nissen fundoplication in improving GERD. Consequently, diagnosis of GERD should not alter the use of RYGB surgery. In contrast, patients with GERD may not do as well with a sleeve gastrectomy as it can either lead to aggravation of GERD or even induce new onset of GERD in asymptomatic patients [40].

Pancreatic Assessment

The follow-up data from the Swedish Obese Subject Study demonstrated that 2- and 10-year rates of recovery from diabetes were higher in the surgical group than in the control group, but that relapse remained a problem [41]. More recent randomized controlled clinical trials indicate that metabolic surgery controls glycemia more effectively than medical care [42, 43]. Nevertheless, very few published algorithms for the management of glycemia immediately before and after surgery exist [44].

A recent Position Statement of the International Diabetes Federation recommends the use of diabetes-specific parameters to monitor the efficacy of treatment when metabolic surgery is performed in patients with T2DM [45]. These recommendations include assessment of glycated hemoglobin levels, C-peptide, fasting glycemia, insulin levels, lipid profile, and regular monitoring of arterial blood pressure, among others [45].

Hepatic Assessment

Nonalcoholic liver disease (NAFLD) is progressive in nature with 20–40% of nonalcoholic steatohepatitis cases turning into liver cirrhosis [46]. NAFLD is predicted to be the primary cause for liver transplantation within the next decade [47, 48]. Mosko and Nguen [49] investigated the bariatric surgical outcomes in patients with and without liver cirrhosis. When compared to patients without liver cirrhosis, the odds ratio for in-hospital mortality was 2.2 for patients with compensated cirrhosis, while patients with ascites and/or history of variceal bleeding had an odds ratio of 21.1. Patients whose clinical examination, medical history or clinical chemistry is suggestive of hepatic disease should therefore undergo a thorough assessment to quantify the severity of liver disease and presence of cirrhosis or portal hypertension. This in any case requires imaging of the liver, often first by ultrasonography which also allows detection of splenomegaly and presence of ascites. If liver cirrhosis is suspected, a fibroscan or more invasive diagnostic tests such as liver biopsy and portal vein pressure measurements can be considered as further investigations.

Some clinicians screen for the presence of cholecystolithiasis which is increased in patients with a BMI >40. However, the indication for a routine concomitant cholecystectomy in patients undergoing bariatric surgery remains controversial. The reported incidence of new-onset symptomatic gallstone disease 3 years after RYGB in studies advocating prophylactic cholecystectomies ranges between 16 [50] and 19% [51].

Plecka Ostlund et al. [52] explained the higher rate of gallbladder disease and need for cholecystectomy by a detection bias in patients undergoing bariatric surgery.

In other studies, symptomatic gallstone disease occurs only in 6.9% of patients after RYGB surgery [53]. Because multivariate analysis identified weight loss at 3 months after RYGB surgery of more than 50% of excess weight as the sole significant independent predictor of delayed symptomatic cholecystolithiasis, these authors concluded that prophylactic cholecystectomy should not be recommended at the time of RYGB [53].

The added risk of a simultaneous cholecystectomy has to be balanced against its expected benefits. For example, there is no doubt that a cholecystectomy is technically less demanding and safer once the patient has lost a significant amount of weight. On the other hand, an altered anatomy after procedures like an RYGB does not allow routine endoscopic investigations anymore and limits potential treatment options such as stent placing in the common bile duct in cases of bile duct injuries after cholecystectomy.

Renal Assessment

Obesity-associated comorbidities like T2DM and hypertension increase not only the risk for cardiac events but also for chronic renal disease which is often overlooked in patients undergoing weight loss surgery [12]. In addition, obesity itself is an independent risk factor for the development and progression of chronic kidney disease [54]. The predominant histological finding in renal biopsies of obesity-related renal disease is glomerulopathy, alone or in combination with segmental glomerular sclerosis. Among the potential underlying pathophysiological mechanisms, activation of the renin-angiotensin-aldosterone system seems to be a key player [55]. Therefore, preoperative assessment for metabolic surgery should provide at least a screening for chronic renal disease.

At present, renal transplant is the only curative treatment for end-stage renal disease. As T2DM and obesity are important causes of graft failure and posttransplant complications, metabolic surgery in patients prior to or after renal or combined pancreas-kidney transplantation could become an important topic in the future. There are case reports of metabolic surgery after renal transplantations [56, 57], as well as case reports of bariatric surgery as a bridge for kidney transplantation in obese patients [58]. The available literature consists of case reports and small case series allowing only vague and general assumptions: both sleeve gastrectomy and RYGB seem to be feasible in patients prior to or after organ transplantation. RYGB surgery may, however, lead to significant changes in the pharmacokinetics of the most common immunosuppressive drugs such as tacrolimus, sirolimus and mycophenolate mofetil [59]. If this justifies the intuitional preference for sleeve gastrectomy in these patients needs to be further studied.

Psychological Assessment

Ideally, preoperative psychological assessment should rule out contraindications and establish patient's readiness for the behavioral challenges following metabolic surgery, in particular the capacity for postoperative compliance. Almost all published studies and textbooks point out psychiatric contraindications for bariatric surgery. According to Bauchowitz et al. [60], contraindications for metabolic surgery have included: substance abuse, severe mental retardation, multiple and recent suicide attempts, and active symptoms of psychosis, bipolar disorder, depression or obsessive compulsive disorder. However, often statements related to psychiatric contraindications remain vague and are based on the assumption that the presence of any psychiatric conditions potentially impairs the patients' ability to cope with surgery [61]. In a survey from 2006, which was referred to mental health professionals involved in the preoperative evaluation of obese patients, 92% listed psychiatric problems as 'clear contraindications' for surgery, but no single disorder or diagnostic category was listed as an important area of assessment or as a contraindication by more than 45% of respondents [62]. Part of the poor agreement was due to the wide variety of assessment methods used. Ashton et al. [63] stated that differences in testing instruments and varying definitions of psychopathological function and psychiatric diagnoses are a major problem in psychological assessment. These authors in fact concluded that currently available methods lack predictive validity for metabolic surgery outcome, and therefore it is not justified to use psychological assessment as an acceptance criterion for surgery. Others find this view too extreme and point out that some test modalities, such as a recent artificial neural network statistical model that incorporates both physical and psychological data, can indeed predict weight loss outcome with acceptable accuracy [64]. Furthermore, predicting surgical outcome is not the only reason for multidisciplinary education of patients undergoing metabolic surgery. For example, in one study preoperative education related to eating habits, psychological implications of surgery, its risks and disadvantages of bar-

Table 1. Modified King's criteria

System/stage	0	I	II	III
Airway	normal	snoring	OSAS with CPAP	cor pulmonale
BMI	<30	30–35	35–50	>50
Body image	normal	does not like looking in mirror	avoids mirrors	severe eating disorder
Cardiovascular	risk <25%	risk >25%	heart disease	heart failure
Daily function	3 flights of stairs	1 or 2 flights of stairs	<1 flight of stairs or walking aids	house bound
Economic	normal	suffered discrimination	unemployed	requires financial support
Gastroesophageal junction	normal	heartburn	esophagitis	Barrett's mucosa
Glucose homeostasis	normal	impaired fasting glycemia	T2DM	uncontrolled T2DM
Gonadal	normal	irregular menses	PCOS/impotence	infertility
Health status	normal	low mood or QoL	moderate depression or poor QoL	severe depression
Kidney	normal	proteinuria	GFR <60 ml/min	GFR <30 ml/min
Liver	normal	pathological LFT/NAFLD	NASH	liver failure

PCOS = Polycystic ovary syndrome; GFR = glomerular filtration rate; LFT = liver function test; NASH = nonalcoholic steatohepatitis.

iatric surgery led 9% of patients to reject a surgery entirely and another 15% to change the type of surgery chosen [65].

However, there is no doubt that it is difficult to convincingly demonstrate the preoperative need for a psychosocial assessment compared to any other investigation during the preoperative assessment of patients planned to undergo metabolic surgery.

Holistic Scoring System

The King's Staging Score is a proposed holistic method to better assess the risks for perioperative complications and patient coping strategies [66]. It includes both somatic parameters and social criteria such as self-estimation, and economic and functional status of the patient (table 1). Further validation and adaptation of such scores may help to better predict surgical outcome and the burden a patient has to bear. However, the more detailed such an assessment is, the more (invasive) personal preoperative investigation is required.

Conclusions

The many comorbidities and complications of morbid obesity are various and include all organ systems. While screening for cardiac diseases and chronic renal disease follows the general preoperative algorithm, metabolic, gastrointestinal and pulmonary assessment has to focus on specific aspects of obesity. The two major criteria for an adverse outcome of bariatric surgery are history of venous thromboembolism and/or OSAS. These conditions should not be missed, and the presence of OSAS may necessitate CPAP preoperatively. The preoperative gastrointestinal assessment should enable the diagnosis of HP-positive gastritis which is common and increases the rate of marginal ulcers postoperatively. EGD is affordable and has a high diagnostic yield, but it is not essential. Psychological assessment at present lacks standardization, and most methods used have insufficient evidence for predictive validity to recommend their use.

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